

et al which seek to achieve their goal which involves combining petroleum distillates such as a diesel fuel and other middle petroleum distillates with esters of branched chain alcohols such as isopropyl esters, 2-butyl esters, and/or tertiary butyl esters synthesized from fats and oils containing fatty acid triglycerides, such as soybean oil (see line 34-40 of column 2). The examiner is correct that the methods developed shown by Johnson, et al also involve the use of methanol as an exchange alcohol, and strong acids such as sulfuric acid and hydrogen chloride. However, the purpose of using these reagents is very different. In this regard, step (a) in claim 1 of this application is well known in the art in and of itself. However, it is asserted that the combination of steps (a), (b) and (c) is not known in the art, especially for improving the long term stability of biodiesel.

The methanol utilized in Johnson et al is to produce the esters which are then mixed with petroleum middle distillates to form a fuel mixture whose crystallization temperature is thereby reduced. Evidently, the use of alcohol, including methanol, to form ester constitutes a crucial step of the Johnson et al invention. This is not the case in the present invention, which concentrates only on the improvement of the long term stability of biodiesel, a methyl ester formed by transesterification of a vegetable or animal fat or oil with methanol, after it is made.

With respect to the use of strong acids both in the Johnson et al disclosure and this invention, the difference is important. Johnson et al teaches to use strong acids such as sulfuric acid and hydrogen chloride as acid catalysts, as also pointed out by the examiner. However, in the present invention, the strong acids are employed to aid splitting the undesired soaps, which are considered as one kind of "crystallization nuclei" contributing to the long term instability of biodiesel. Therefore the presence of these acids in both Johnson et al and the present invention involves completely different mechanisms. In the prior art to Johnson, et al, all the steps of acid application, water washing, stirring, and emulsion formation, occur during a transesterification phase, namely step (a), and before the downstream workup and purification process described in the current invention to improve the long term stability of biodiesel.

An important feature of the present invention is to intentionally form an emulsion by the use of an intensive inline mixing apparatus. As the examiner appreciates, the micelles created by an emulsion ensures a very large surface area between the ester phase and the aqueous phase, and thus an enhanced mixing effect and the removal of the impurities is achieved. The emulsion then breaks and a stable interphase between a washed ester phase and the wash phase is formed. As evidence, reference is made to Figure 1 and the 4th paragraph on page 4 of the specification, where it clearly shows that those are only steps to prepare the crude biodiesel for the current invention to purify and to remove the crystallization nucleus thereof, with the new and inventive steps delineated in step (b) and (c) in claim 1. Paragraph 4 on page 4 states "The crude ester formed by transesterification of vegetable or animal fat or oil ... is initially present in a mixture with the split off glycerin. This mixture contains as impurities, unreacted methanol, soaps, free glycerin residual alkaline catalyst... In the Settler 1, the heavy phase containing the glycerin and residual catalyst is separated and fed back into reactor 1 employed for the transesterification." As depicted, the catalyst (the alkaline catalyst mentioned here is only an example of the catalysts which can be used and is the counterpart of the acid catalyst mentioned in the prior art documents) is reintroduced into the transesterification step, and new mixture of a strong acid and a complex former is utilized in the "Inline Mixer" to remove the impurities. It can thus be unambiguously derived that, the concept and the idea of utilization acids are fundamentally different here in the invention concerned than in the state of the art. Emulsion formation is also formed in this step instead in the transesterification step. In other words, the transesterification step is of no particular interest to the present invention, but rather the downstream purification step, steps in "Inline Mixer", "Settler 2" and "wash column" as demonstrated in Figure 1 are the focus. It is submitted that it is not obvious for those skilled in the art to suggest using acid and emulsion formation to remove the impurities in the crude biodiesel based on the teaching of the cited prior art documents, since all of these references focus only on the transesterification of certain oils with methanol. The presence of crystallization nuclei and the problem of long term instability have not even been mentioned therein, let alone this would require a fundamentally different knowledge of the properties and usage of acids.

There is no mention whatsoever in Johnson et al, of forming an emulsion. It is only disclosed in line 22-24 of column 4 in Johnson et al that "The reaction mixture was stirred vigorously at 32°C. Esterification was monitored by TLC. After 6 hours, 300g hexane and 300 ml water were added to the reaction mixture to induce a phase separation."

In an effort to fill this void, the examiner has cited a secondary reference to Kovacs, et al (WO 03/040081), which allegedly comments on the methods developed by Johnson et al. The approach disregards the original Johnson et al disclosure and relies on an indirect resource. The scope of protection of a patent is defined by its claims, which are supported and/or interpreted by its description and drawings. To allow the interpretations extends beyond the original disclosure and by not even a well established teaching of common knowledge leads undoubtedly to great uncertainty.

The second paragraph of page 3 by Kovacs, et al, as cited by the examiner, actually refers to two documents, namely U.S. patents No. 5,520,708 and 6,015,444. So, the comments stated in the paragraph do not exclusively refer to U.S. patent 5,520,708 by Johnson et al. Surprisingly, U.S. 6,015,444, does not pertain to the production of biological oils, rather it belongs to a totally unrelated area of mechanical engineering, namely "An apparatus and system for venting a transmission". The foregoing leads to doubt and that there might very well have been a mistake in referencing the background state of the art in the text by Kovacs, et al.

The above notwithstanding, even if the aforementioned paragraph by Kovacs, et al, is credible and attention to it is required to fully understand the teaching by Johnson, et al, one can only draw the conclusion from this paragraph that the emulsion supposedly formed in Johnson, et al is conducted only during the transesterification stage and serves only to mix the reactants including catalysts intensively. It has literally been stated that "The lifespan of the emulsion formed in the homogenizer enables transesterification to proceed to equilibrium conversion before the emulsion segregates in the settler." Completely differently, the present invention utilizes an emulsion after transesterification to remove impurities. Therefore the comment of Kovacs, et al can by no means negate the non-obviousness of the present invention, if it is at all relevant.

The examiner is further of the view that both the Johnson, et al and the present invention teach washing the reaction mixture and subject the mixture to drying. Once again, this position is inappropriate since these steps are involved in different stages in the two inventions, with one being after the transesterification stage and the other one being after the removing the impurities which cause the long term instability of biodiesel. The washing and drying steps are not the principal steps of the present invention, rather the important features are the formation of an emulsion and the introduction of strong acids and complex former during the formation of the emulsion to maximize the removal of the impurities.

With respectfully submitted that the combination, Johnson, et al plus Kovacs, et al does not render the instant invention obvious. They each address completely different technical problems, which then lead to totally different methods utilized to solve their problems. Those skilled in the art are most unlikely to form the present invention upon a review of the teachings of Johnson, et al and Kovacs, et al. The key features of the present invention are totally absent in the disclosure of the combination of Johnson, et al and Kovacs, et al to solve the technical problem at hand. Therefore, for all of the above reasons, it is respectfully urged that the 35 U.S.C. 103 rejection should be withdrawn.

The undersigned respectfully requests re-examination of this application and believes it is now in condition for allowance. Such action is requested. If the Examiner believes there is any matter which prevents allowance of the present application, it is requested that the undersigned be contacted to arrange for an interview which may expedite prosecution.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'R. S. Roberts', is written over a horizontal line.

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